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ABSTRACT

Reported is a study of the development of a set of elementary school science teaching competencies with significant elementary school teacher input and of a comparison of ratings of elementary school teachers with science teacher educators on three scales: (1) when a competency should be taught, (2) what role the university should have in teaching a competency, and (3) how important the competency is to elementary science teaching. Competencies were generated and grouped and then rated by 14 elementary classroom teachers and 7 teacher educators. The responses of these two groups furnished the data base. Comparison of data was made using the Mann-Whitney U statistic. There were significant differences between the ratings of the two groups on 19 percent of the 230 competencies selected for items in the study. The items in this 19 percent group fell into the categories of Control, Materials, Inservice Opportunities, and Involvement of Students. In general, teacher educators rated inservice opportunities, child-centered activities, and use of material competencies higher than did the teachers. Teachers rated classroom control and organization of materials as being more important for science education than did the teacher educators. (Author/EB)

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**A Comparison of Ratings of
Elementary Science Teaching Competencies
by Teachers and Teacher Educators**

**A paper presented to
The National Association for
Research in Science Teaching**

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A Comparison of Ratings of
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The evaluations and assessment of competencies has two large components. The first is the evaluation of the competency itself, the second is the evaluation of students to find how well they have obtained the stated competency. This paper addresses the former.

The objectives of the inquiry were:

- 1) To develop a set of elementary school science teaching competencies with significant elementary school teacher input.
- 2) To compare the ratings of elementary school teachers with science teacher educators on two scales:
 - A) when a competency should be attained.
 - B) how important the competency is to elementary science teaching.

Under a grant from the Michigan State Department of Education, the University of Michigan in cooperation with the elementary school teachers in the Ann Arbor, Michigan, area developed a list of 230 competencies. The competencies were chosen as "Characteristics a competent elementary teacher should have in order to teach science."¹

Methodology and Design

Classroom teachers, administrators, and teacher educators gathered on a voluntary basis to write competencies. Of the 19 participants, 13 were elementary classroom teachers, 2 were administrators, and 4 were teacher educators. These competencies were grouped into ten categories which were: Philosophy of Teaching, Safety, Resources, Materials, Personal Education, Teaching Strategy, Assessment, Classroom Management, Curriculum, and Teaching Background.

To first evaluate the competencies, similar competencies from each group were edited to obtain a single competency statement. Then the competencies were ranked by the teachers as to importance for elementary science teaching and how much involvement the University of Michigan should have in developing the competency. Teachers rated the competencies from 1 to 7 in importance and from 1 to 4 in University involvement. The ratings of 14 teachers and 4 teacher educators were analyzed. Means and standard deviations were generated for all competencies. Competencies were removed if two conditions were met. The competency had to be rated less than average in importance and also be rated in the lower quartile for University involvement. Of the 230 competencies, 50 met both conditions and were considered for dropping. Analysis of those competencies considered for rejection indicated a difference in ratings between teachers and teacher educators. To find if the difference in rating was significant, data about the 230 competencies were run through the MIDAS computer program

system where a Man Whitney U Test was performed.² The Man Whitney U Test was performed because it allows relaxation of parametric assumptions of normality necessary for a small N.³ Of the 230 competencies, 44 (approximately 20%) were significantly different at the $\alpha = .05$ level in either importance for science teaching or University of Michigan involvement. A list of the 44 competencies showing such differences is shown in Appendix I. Competencies which occurred on this list and were included in the list of 50 competencies which were selected for removal were reinstated for purposes of future research.

Independent consensus and editing was done during this time by assessment specialists. The project staff synthesized the products and further reduced the list to a final list of 143 competencies. This list may be found in Appendix II.

Data Sources

To explore differences between teachers and teacher educators as they ranked competencies, the sample was increased. The resulting data base consisted of 22 teachers and 18 teacher educators. Analysis of variance indicated that more differences occurred when 8 teachers in areas around Ann Arbor were included and 11 teacher educators not directly involved in science education were included. Differences in ratings occurred in 66 of 143 competencies (approximately 46%).

Of interest was the distribution of differences when compared to when a competency should be attained. Using

modes of the entire sample the competencies were categorized as to when the competency should be obtained. The categories and differences in ratings between teachers and teacher educators are shown in Table 1.

Table 1

Categories and Differences between Teachers and
Teacher Educators on Ratings of Competencies

<u>Category</u>	<u>Differences in Percent</u>
1) Before entering an education program.	40%
2) Initial field experience (observation).	30%
3) Undergraduate education courses.	45%
4) Student teaching.	41%
5) In-service experience.	73%
6) In-service workshops, professional meeting and education courses.	100%

The 66 competencies which indicated a difference in ratings between teachers and teacher educators are shown in Appendix III. Numbers appearing beside each competency indicate the category. The direction of difference is indicated by an asterisk beside each of those competencies rated as more important or should be attained earlier by teacher educators. Note that 25 of 33 competencies (75%) were rated as more important or should be attained earlier

by teacher educators. Note also that 25 of 33 competencies (75%) were rated earlier by teacher educators.

Conclusions

As can be concluded from this preliminary research, large differences between ratings of teachers and teacher educators were found--teacher educators appear to attach less importance to classroom discipline and record keeping and more importance to working with students. Teacher educators appear to believe that competencies should be attained earlier in the student's career.

Significance

The development of a model using teacher input in competency writing may be necessary to discover differences between groups which are extremely necessary in educating new teachers. The impact to a teacher program of differences between teachers in the field and teacher educators cannot be overstated. As an example, supervising teachers in the field may place a very important value on competencies which have received low or no value by teacher educators. Such differences in perception may create critical problems for student teachers who may not be aware of the source of such problems.

Finally, the differences found between teachers and teacher educators indicate that assessment of the competencies themselves is as important a task as assessing students' attainment of the tasks and should be included in any competency based program.

References Cited

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- (2) Fox, D. and Guire, K. 1973. Michigan Interactive Data Analysis System. University of Michigan, Ann Arbor.
- (3) Sieger, S. 1956. Nonparametric Statistics for the Behavioral Sciences. McGraw Hill, New York.

APPENDIX I

COMPETENCIES WITH SIGNIFICANT DIFFERENCES
BETWEEN TEACHERS
AND
TEACHER EDUCATORS

18500	UTILIZE FREE AND INEXPENSIVE MATERIALS
18764	UTILIZE PROCESS OF MEASURING (METRIC)
20404	ESTABLISH WITH CHILDREN IMPORTANCE OF APPLYING SCIENCE KNOWLEDGE IN CR
21203	SELECT AND INVOLVE COMMUNITY RESOURCES
22603	PARTICIPATE IN INSERVICE WORKSHOPS
22604	RELATE SCIENCE TO DAILY LIFE
23102	MAINTAIN ROOM CLEANLINESS AND ORGANIZATION WITH CHILDREN
23702	LOCATE AND EVALUATE NEW MATERIALS
24004	EVALUATE ACTIVITY AND REORGANIZE WHEN UNSUCCESSFUL
24404	INCORPORATE ORGANIZATION IN PREPARATION AND ARRANGEMENT OF MATERIALS
24402	SYNTHESIZE RELEVANT MATERIAL INTO THE CURRICULUM
25502	PLAN CHILD-CENTERED ACTIVITIES
25502	MAINTAIN EFFECTIVE CLASSROOM CONTROLS
26023	INCORPORATE FEEDBACK FROM STUDENTS
26604	RESPOND TO UNEXPECTED SITUATIONS EFFICIENTLY AND WITH COMMON SENSE
26603	PREPARE LESSON PLANS AND MATERIALS
28202	EVALUATE PROGRESS ON GOALS WITH INDIVIDUAL CHILDREN AND GROUPS OF CHILD
28304	DESIGN SCIENCE MATERIALS FROM TRASH OR JUNK
30944	DEMONSTRATE PROPER CLASSROOM CARE FOR LIVING THINGS
31202	RECOGNIZE POSITIVE STUDENT INFORMATION AND SHARE IT WITH OTHER TEACHER
31304	UTILIZE MEASURING SYSTEMS WHICH ARE RELEVANT TO STUDENTS
31502	USE LIBRARY RESOURCES OF SCHOOL OR COMMUNITY
31801	PROVIDE ATMOSPHERE FOR RESPECT
32002	UTILIZE IN-SERVICE TRAINING OPPORTUNITIES
32203	ASK DIFFERING COGNITIVE QUESTIONS
32703	ESTABLISH MEDIA CENTER FOR INDIVIDUAL RESEARCH
32902	DEMONSTRATE ABILITY TO EFFECTIVELY COMMUNICATE WITH VARIOUS TYPES OF E
33704	DEVELOP IN STUDENTS EXCITEMENT AND ENTHUSIASM FOR SCIENCE
34103	USE A VARIETY OF CLASSROOM OBJECTIVES
34502	VISIT OTHER CLASSROOMS
34704	REGAIN POSITIVE EQUILIBRIUM AFTER DISCOURAGING EVENTS
35504	DEVELOP LESSONS WHICH RELATE TO THE STUDENTS
36804	CONTROL EXPERIMENTAL VARIABLES

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36902	USE VARIETY OF AUDIO-VISUAL MATERIALS
37102	DESIGN REALISTIC TESTS AND WORKSHEETS
37201	SELECT COLLECTION MATERIALS CRITICALLY
37804	IDENTIFY VALUE FOR MAINTAINING LIVING THINGS IN THE CLASSROOM
39434	UTILIZE PROCESS OF HYPOTHESIS TESTING
39601	KEEP RECORDS OF MATERIALS
39802	PERFORM DEMONSTRATIONS
40423	FORMULATE ACCURATE UP-TO-DATE RECORDS OF STUDENT ACHIEVEMENT
40803	DEVELOP VOCABULARY OPERATIONALLY (THROUGH USE)
41300	CONSTRUCT SIMPLE EQUIPMENT
41400	UTILIZE PROFESSIONAL JOURNALS FOR INSTRUCTION AND RESEARCH

APPENDIX II

MASTER LIST OF ELEMENTARY SCHOOL
SCIENCE TEACHING COMPETENCIES
BY CATEGORY

MASTER LIST OF ELEMENTARY SCHOOL SCIENCE TEACHING COMPETENCIES
BY CATEGORY

ACADEMIC BACKGROUND

- 193 DEMONSTRATE UNDERSTANDING OF CONSTANT CHANGE
- 197 DEMONSTRATE UNDERSTANDING OF ECOSYSTEMS
- 220 KNOW DEVELOPMENTAL STAGES
- 223 DEMONSTRATE ABILITY TO RESEARCH AND ORGANIZE FACTS
- 239 KNOW CONTENT ENOUGH TO RESPOND TO STUDENT QUESTIONS
- 252 KNOW METHODS OF SCIENTIFIC INQUIRY
- 257 KNOW MICHIGAN MINIMAL PERFORMANCE OBJECTIVES
- 277 DEMONSTRATE UNDERSTANDING OF SPACE AND TIME CONCEPTS
- 298 DEMONSTRATE UNDERSTANDING OF STRUCTURAL PATTERN CONCEPTS
- * 309 DEMONSTRATE PROPER CLASSROOM CARE FOR LIVING THINGS
- 353 DEMONSTRATE UNDERSTANDING OF GEOLOGICAL CONCEPTS
- 375 UTILIZE LOGIC IN SCIENTIFIC INVESTIGATION
- 382 DEMONSTRATE UNDERSTANDING OF CONSERVATION OF MATTER AND ENERGY
- 387 DEMONSTRATE UNDERSTANDING OF INTERDEPENDENCE OF LIVING OBJECTS
- 399 DISCRIMINATE PROPERTIES OF LIVING AND NONLIVING OBJECTS AND CLASSIFY
- 405 DEMONSTRATE UNDERSTANDING OF ENERGY CONCEPTS
- 406 DEMONSTRATE UNDERSTANDING OF INTERACTION CONCEPTS

ASSESSMENT

- 189 EVALUATE APPROPRIATENESS OF MATERIALS AND ACTIVITIES RELATIVE TO THE
- 210 EVALUATE SCIENCE PROGRAMS
- 230 EVALUATE LESSONS AND TEACHING PROCEDURES
- * 240 EVALUATE ACTIVITY AND REORGANIZE WHEN UNSUCCESSFUL
- 250 ANALYZE SITUATION TO DETERMINE APPROPRIATE ASSESSMENT MODES
- * 260 INCORPORATE FEEDBACK FROM STUDENTS AND PARENTS
- 273 GENERATE CONSTANT FEEDBACK TO STUDENTS
- 281 APPLY CONTINUOUS SELF-EVALUATION PROCEDURES
- * 282 EVALUATE PROGRESS ON GOALS WITH INDIVIDUALS AND GROUPS
- 287 FORMULATE REALISTIC GROUP AND INDIVIDUAL EXPECTATIONS
- 292 EVALUATE USE OF MEDIA
- 356 EVALUATE INTERACTION OF SELF AND STUDENTS
- 367 INVOLVE CHILDREN IN SELF-EVALUATION
- 395 EVALUATE HOW WELL EACH CHILD'S NEEDS HAVE BEEN MET
- * 396 KEEP RECORDS OF MATERIALS
- * 404 FORMULATE ACCURATE UP-TO-DATE RECORDS OF STUDENT ACHIEVEMENT

* Those competencies with significant differences in ratings among teachers and teacher educators.

CLASSROOM MANAGEMENT

- 191 DEMONSTRATE ABILITY TO MANAGE GROUPS OF VARIOUS SIZES
- 216 ORGANIZE CLASSROOM WITH CHILDREN TO PROVIDE LEARNING VARIETY
- 722 ESTABLISH A CREATIVE AND ATTRACTIVE LEARNING ENVIRONMENT
- * 231 MAINTAIN ROOM CLEANLINESS AND ORGANIZATION WITH CHILDREN
- 233 FORMULATE ROUTINES AND CLASSROOM LIMITS WITH CHILDREN
- * 258 MAINTAIN EFFECTIVE CLASSROOM DISCIPLINE
- * 266 RESPOND TO UNEXPECTED SITUATIONS EFFICIENTLY AND WITH COMMON SENSE
- 288. ESTABLISH ENVIRONMENT TO ENCOURAGE ORGANIZATION AND SHARING
- 366 ESTABLISH AN OPEN, RELAXED CLASSROOM ENVIRONMENT
- 370. DEMONSTRATE SENSE OF FAIRNESS THROUGH CONSISTENCY
- 402 ESTABLISH CLASSROOM ENVIRONMENT WHICH DEVELOPS INDIVIDUAL LEARNING

CURRICULUM

- * 187 INVOLVE STUDENTS IN UTILIZING THE PROCESS OF MEASURING (METRIC)
- 192 INVOLVE STUDENTS IN UTILIZING THE PROCESS OF COMMUNICATING
- * 229 ADAPT MATERIAL RELATING TO DAILY LIFE INTO THE CURRICULUM
- 246 UTILIZE VARIOUS SUB-GROUPS OF SOCIETY AND OF THE LOCAL COMMUNITY
- * 254 SYNTHESIZE RELEVANT MATERIAL INTO THE CURRICULUM
- 259 INVOLVE STUDENTS IN UTILIZING THE PROCESS OF OBSERVING
- 284 INVOLVE STUDENTS IN UTILIZING THE PROCESS OF INTERPRETING DATA
- 285 INVOLVE STUDENTS IN UTILIZING THE PROCESS OF CLASSIFYING
- 286 SELECT CONTENT WITH SUFFICIENT DEPTH FOR MULTIPLE ACTIVITIES
- 289 INVOLVE STUDENTS IN UTILIZING THE PROCESS OF PREDICTING
- 294 DEVELOP CONCEPT OF INTERRELATIONSHIP OF ORGANISMS AND THEIR ENVIRONMENT
- * 313 UTILIZE MEASURING SYSTEMS WHICH ARE RELEVANT TO STUDENTS
- 334 DEVELOP AND USE CLEARLY DEFINED PERFORMANCE OBJECTIVES
- 363 INVOLVE STUDENTS IN UTILIZING THE PROCESS OF RECORDING
- * 378 PROVIDE GUIDANCE IN STUDENT MAINTAINANCE OF ORGANISMS IN CLASSROOM
- 381 INCORPORATE READING AND MATH SKILLS
- 392 ESTABLISH CONTENT BACKGROUND APPROPRIATE TO TEACHING LEVEL
- 393 INVOLVE STUDENTS IN UTILIZING THE PROCESS OF FORMULATING HYPOTHESIS
- * 394 INVOLVE STUDENTS IN UTILIZING THE PROCESS OF HYPOTHESIS TESTING

MATERIALS

- *185 UTILIZE FREE AND INEXPENSIVE MATERIALS
- *237 LOCATE AND EVALUATE NEW MATERIALS
- 243 SELECT AND USE APPROPRIATE MEDIA, MATERIALS, AND RESOURCES
- *244 INCORPORATE ORGANIZATION IN PREPARATION AND ARRANGEMENT OF MATERIALS
- 263 PREPARE LIVING MATERIALS FOR CLASSROOM USE
- 276 OPERATE SCIENCE EQUIPMENT
- *283 DESIGN SCIENCE MATERIALS FROM TRASH OR JUNK
- 303 USE RELEVANT PRINTED MATERIALS
- 323 MODIFY MATERIALS FOR CLASSROOM ACTIVITIES
- *327 ESTABLISH MEDIA CENTER FOR INDIVIDUAL RESEARCH
- 332 CONSTRUCT AND CARE FOR AQUARIA AND TERRARIA
- 346 LOCATE SCIENCE EQUIPMENT SOURCES FOR A SPECIFIC CLASSROOM/TEACHER
- 357 FIND APPROPRIATE REFERENCE MATERIAL
- *369 USE AND OPERATE A VARIETY OF AUDIO-VISUAL MATERIALS AND/OR EQUIPMENT
- *372 SELECT COLLECTION MATERIALS CRITICALLY (E.G., ROCKS AND MINERALS)
- 385 PLAN AND ORGANIZE FOR USE OF MANIPULATIVE MATERIALS
- 390 USE A VARIETY OF MATERIALS
- *413 CONSTRUCT SIMPLE EQUIPMENT

PERSONAL DEVELOPMENT (PUPIL OR TEACHER)

- 209 GUIDE CHILDREN IN MAKING REALISTIC GOALS AND CHOICES
- 214 EXPAND PROFICIENCY IN SCIENCE EDUCATION BEYOND PRESERVICE
- *226 PARTICIPATE IN INSERVICE WORKSHOPS
- 290 ORGANIZE EXPERIENCES WHICH WILL GIVE CHILDREN POSITIVE RELATIONSHIPS
- 308 RECOGNIZE ASPECT OF HUMOR AND UNPLANNED DISCOVERY IN CLASSROOM EXPERIENCE
- *318 PROVIDE ATMOSPHERE FOR RESPECT
- *320 UTILIZE IN-SERVICE TRAINING OPPORTUNITIES
- 326 DEVELOP CONTINUING INTEREST IN NEW SCIENCE FINDINGS
- *329 DEMONSTRATE ABILITY TO EFFECTIVELY COMMUNICATE WITH VARIOUS PEOPLE
- 344 APPRECIATE VALUE IN STUDENT RESPONSE
- *345 VISIT OTHER CLASSROOMS
- *347 REGAIN POSITIVE EQUILIBRIUM AFTER DISCOURAGING EVENTS
- 354 DEMONSTRATE FOLLOW THROUGH ON COMMITMENTS
- 359 BE TACTFUL WITH STUDENTS
- 384 SHARE MUTUAL RESPECT FOR SELF AND OTHERS
- 397 RECOGNIZE INDIVIDUAL CHILD'S GOALS, STRENGTHS, WEAKNESSES, NEEDS

PHILOSOPHY

- 321 CREATE AN APPRECIATION FOR THE BEAUTY, WONDER AND OPENNESS OF SCIENCE
- 271 DISTINGUISH BETWEEN VALUE JUDGMENT AND POINT OF VIEW

RESOURCES

- * 212 SELECT AND INVOLVE COMMUNITY RESOURCES
- 232 USE STUDENTS AS RESOURCE
- * 315 USE LIBRARY RESOURCES OF SCHOOL OR COMMUNITY
- 342 USE ENVIRONMENT AS A SCIENCE LABORATORY
- * 414 USE PROFESSIONAL JOURNALS FOR INSTRUCTION AND RESEARCH

SAFETY

- 202 RECOGNIZE AND EVALUATE SAFETY HAZARDS IN EVERYDAY EXPERIENCES
- 251 USE SAFETY PROCEDURES IN SCIENCE EXPERIMENTS AND DEMONSTRATIONS
- 306 KNOW STATE AND SCHOOL SAFETY RULES
- 325 STRUCTURE ACCIDENT PROCEDURES FOR CHILDREN
- 333 DEVELOP SAFETY CONSCIOUSNESS IN THE STUDENTS

TEACHING STRATEGIES

- 186 UTILIZE GAMES AND SIMULATIONS
- 201 PLAN AND CONDUCT FIELD TRIPS
- * 204 ESTABLISH WITH CHILDREN IMPORTANCE OF APPLYING SCIENCE KNOWLEDGE
- 217 USE POSITIVE REINFORCEMENT TECHNIQUES
- 228 USE VARIOUS QUESTIONING TECHNIQUES, COGNITIVE AND AFFECTIVE
- 235 INCORPORATE SPONTANEOUS CLASSROOM CHANGES INTO LESSONS
- * 255 PLAN CHILD-CENTERED ACTIVITIES
- 261 PROVIDE FOR ACTIVE STUDENT PARTICIPATION AND DISCUSSION
- 264 PLAN ACTIVITIES APPROPRIATE TO AVAILABLE TIME
- * 268 PREPARE LESSON PLANS AND MATERIALS
- 275 USE INDUCTIVE AND DEDUCTIVE REASONING
- 279 USE STUDENT'S IDEA TO DEVELOP LOGICAL SOLUTION TO A PROBLEM
- 299 UTILIZE TEACHING BEHAVIORS WHICH MOTIVATE STUDENTS
- 300 DEVELOP QUESTIONING OF CONCLUSIONS
- 310 ASK QUESTIONS APPROPRIATE TO CONTENT AND AGE LEVEL
- 311 FORMULATE MEANINGFUL EXPERIENCE FROM EXPERIMENTAL FAILURE
- 314 INCORPORATE AN ATMOSPHERE OF SCIENTIFIC CURIOSITY AND CONDUCT
- 319 REFRAIN FROM FORCING CONCLUSIONS
- * 322 ASK DIFFERING COGNITIVE QUESTIONS
- 331 ESTABLISH OPEN-ENDED DISCUSSIONS
- 336 USE PUPIL-TEACHER AND PUPIL-PUPIL PLANNING
- * 337 DEVELOP IN STUDENTS EXCITEMENT AND ENTHUSIASM FOR SCIENCE
- 338 USE EXPERIMENTS WHICH UTILIZE THE SCIENTIFIC PROCESSES
- 343 PROVIDE INDIVIDUAL AND GROUP INSTRUCTION
- * 355 DEVELOP LESSONS WHICH RELATE TO THE STUDENTS
- 361 DEVELOP SELF-DIRECTIVE SMALL GROUPS
- * 368 CONTROL EXPERIMENTAL VARIABLES
- 373 PROVIDE A VARIETY OF LEARNING SITUATIONS
- 383 PROVIDE FOR FURTHER STUDENT INQUIRY
- 386 USE PROBLEM APPROACH
- * 398 PERFORM DEMONSTRATIONS
- 401 IMPLEMENT A VARIETY OF ACTIVITIES CONCURRENTLY
- 403 INVOLVE STUDENTS IN OPEN EXPLORATION
- * 408 DEVELOP VOCABULARY OPERATIONALLY (THROUGH USE)

APPENDIX III

COMPETENCIES IN WHICH THERE WERE
SIGNIFICANT DIFFERENCES BETWEEN RATINGS
OF
TEACHERS AND TEACHER EDUCATORS

When the Competency should be First Attained

Before entering an education program

Develop concept of interrelationship of organisms and their environment. (1*)
Demonstrate ability to effectively communicate with various people. (1*)
Regain positive equilibrium after discouraging events. (1*)
Respond to unexpected situations efficiently and with common sense. (1-)

Initial field experience (observation)

Use library resources of school or community. (2*)

Undergraduate education courses

Use professional journals for instruction and research. (3-)

Student teaching

Use student's idea to develop logical solution to a problem. (4*)
Develop questioning of conclusions. (4-)
Guide children in making realistic goals and choices. (4*)
Involve students in utilizing the process of hypothesis testing. (4*)
Develop safety consciousness in the students. (4*)
Develop in students excitement and enthusiasm for science. (4-)
Develop lessons which relate to the students. (4*)
Involve students in utilizing the process of measuring (metric). (4*)
Control experimental variables. (4*)
Select and involve community resources. (4*)
Formulate accurate up-to-date records of student achievement. (4*)
Provide atmosphere for respect. (4-)
Establish open-ended discussions. (4*)
Use various questioning techniques, cognitive and affective. (4*)
Formulate meaningful experience from experimental failure. (4-)
Incorporate spontaneous classroom changes into lessons. (4*)
Demonstrate proper classroom care for living things. (4*)
Provide guidance in student maintenance of organisms in classroom. (4*)

In-service experience.

Establish with children importance of applying science knowledge. (5*)
Structure accident procedures for children. (5*)
Locate science equipment sources for a specific classroom/teacher. (5*)
Utilize various sub-groups of society and of the local community when planning instruction. (5*)
Adapt materials relating to daily life into the curriculum. (5-)
Analyze situation to determine appropriate assessment modes. (5*)

In-service experience con't.

Apply continuous self-evaluation procedures. (5*)

Establish media center for individual research. (5-)

In-service workshops, professional meetings and education courses

Develop continuing interest in new science findings. (6*)

Competencies in which there were Significant Differences
between Ratings of Teachers and Teacher Educators

Importance for Science Teaching

Before entering an education program

Recognize and evaluate safety hazards in everyday experiences. (1*)
Demonstrate follow through on commitments. (1*)
Share mutual respect for self and others. (1*)
Distinguish between value judgment and point of view. (1*)
Know methods of scientific inquiry. (1*)

Initial field experience (observation)

Utilize free and inexpensive materials. (2*)
Visit other classrooms. (2*)

Undergraduate education courses.

Plan child-centered activities. (3*)
Select collection materials critically (e.g., rocks and minerals). (3*)
Design science materials from trash or junk. (3*)
Incorporate organization in preparation and arrangement of materials. (3-)
Construct simple equipment. (3*)
Use problem approach. (3*)
Use and operate a variety of audio-visual materials and/or equipment. (3-)
Prepare lesson plans and materials. (3*)
Locate and evaluate new materials. (3*)

Student teaching

Maintain effective classroom discipline. (4-)
Perform demonstrations. (4-)
Maintain room cleanliness and organization with children. (4-)
Evaluate progress on goals with individuals and groups. (4*)
Utilize measuring systems which are relevant to students. (4*)
Construct and care for aquaria and terraria. (4*)
Evaluate activity and reorganize when unsuccessful. (4-)
Develop vocabulary operationally (through use). (4-)
Ask differing cognitive questions. (4*)

In-service experience

Keep records of materials. (5-)
Incorporate feedback from students and parents. (5*)
Synthesize relevant material into the curriculum. (5*)

In-service workshops, professional meetings and education courses

Participate in in-service workshops. (6*)

Utilize in-service training opportunities. (6*)

Expand proficiency in science education beyond pre-service. (6*)